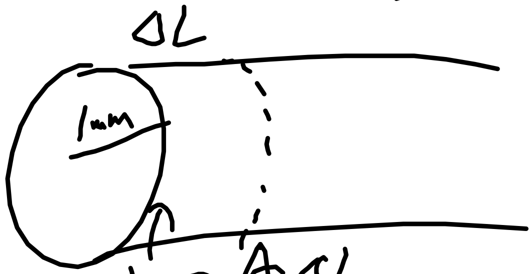
p 477

Q9

$I = 1A \longrightarrow$



$V = A\Delta L$

Cu $\rho = 10^{29} \frac{e^-}{m^3}$

v of e^- drift?

$\rho = \frac{q}{V}$

$I = \frac{q}{t} = \frac{\rho A \Delta L}{t}$

$I = \rho A v \quad v = \frac{I}{\rho A}$

$$v = \frac{1.0A}{10^{29}\frac{e^-}{m^3}\left(\frac{1.6\times10^{-19}C}{e^-}\right)\left(\pi(1.0\times10^{-3}m)^2\right)}$$

$v =$ 1/(1E29x1.6E-19x3.14159x1E-6)=
2.0E-5 = 2.0 x 10^{-5}m/s

Hey, why do the lights turn on right away then?

Because the wires are filled with electrons (like

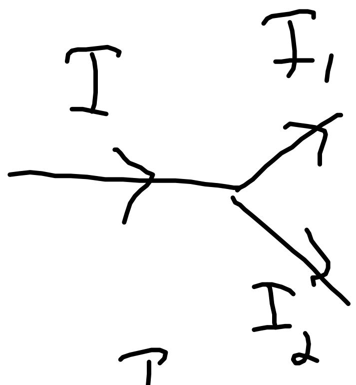
the pipes are filled with water), though they drift slowly, the electric field moves near the speed of light.

Laws of conservation of energy and charge.

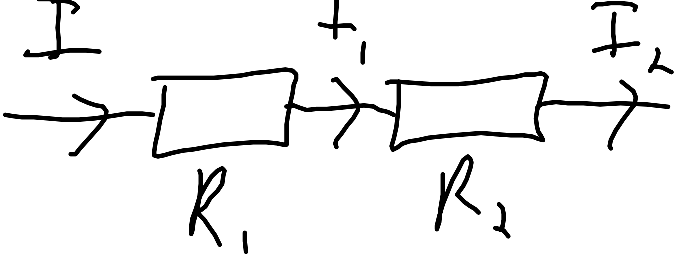
Energy in to the circuit (from the battery or power supply) equals the energy out of the circuit (heat dissipated by the resistors, light given off from bulbs/diodes, kinetic energy/work of motors).

Charge is also conserved, so the current out of the battery, must equal the current back into the battery. So, if there is a junction in a circuit, the current into the junction must equal the current out.

Kirchhoff's Laws:
Junction Law -



$I = I_1 + I_2$

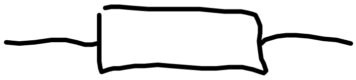


$I = I_1 = I_2$

Kirchhoff's Loop Law or Voltage Law:

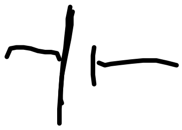
symbol

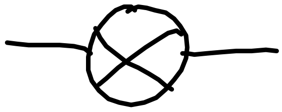
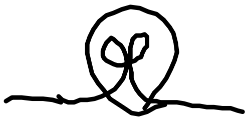
symbol

resistor 

battery 

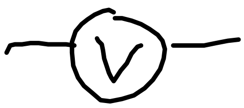
memorize

Cell 

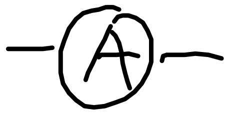
bulb  or 

diode 

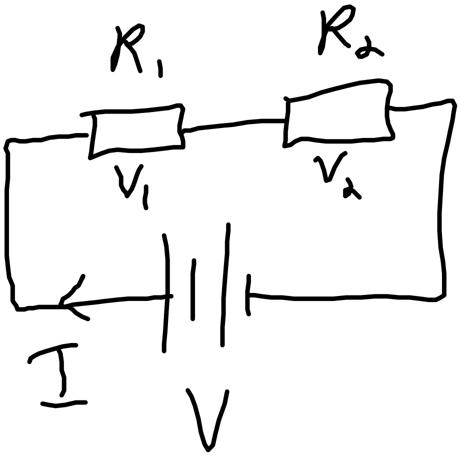
switch 

Voltmeter 

Parallel

Ammeter 

Series with a resistor or blow fuse



$$P_{in} = P_{out}$$

$$VI = V_1 I_1 + V_2 I_2$$

$$I = I_1 = I_2$$

$$V = V_1 + V_2$$

or $V - V_1 - V_2 = 0$

in (V) out (V_1, V_2)

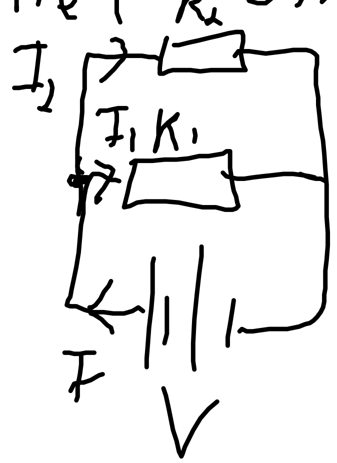
$R_T = \frac{V}{I}$ ← equivalent resistance

Since $V = V_1 + V_2$

$$IR_T = IR_1 + IR_2$$

$$R_T = R_1 + R_2$$

Parallel Circuit



$$P_{in} = P_{out}$$

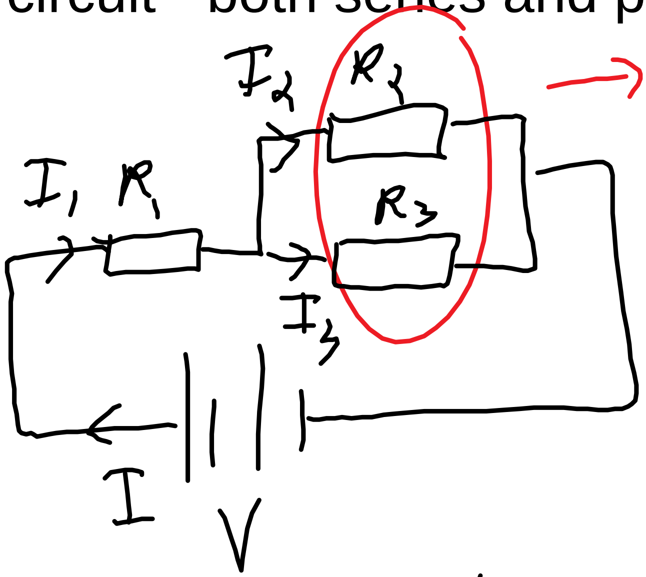
$$VI = V_1 I_1 + V_2 I_2$$

$$I = I_1 + I_2$$

So $V = V_1 = V_2$

Circuit elements in parallel have the same voltage drop across the elements.

Mixed circuit - both series and parallel



$\rightarrow \frac{1}{R_T} = \frac{1}{R_2} + \frac{1}{R_3}$

Parallel circuit

Kirchhoff's Junction Law $I = I_2 + I_3$

Kirchhoff's Loop Law $V = V_1 + V_2$ outside loop

$V = V_1 + V_3$ inside loop

$R_T = ?$

Parallel $I = I_2 + I_3$

$$\frac{V_{parallel}}{R_T} = \frac{V_2}{R_2} + \frac{V_3}{R_3}$$

$$V_{Pral} = V_2 = V_3.$$

$$\frac{1}{R_T} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$R_T = R_1 + R_{T_{parallel}}$$

eg. set $R_1 = 50\Omega$, $R_2 = 100\Omega$ and $R_3 = 200\Omega$ and $V = 6.0$ V.

a) in the circuit diagram, show the placement of the voltmeter and ammeter to measure the voltage across and current through R_2.
b) What is the equivalent resistance of the parallel portion of the circuit?
c) What is the equivalent resistance of the whole circuit?
d) What is the current out of the battery?
e) What is the voltage drop across R_1?
f) What is the reading on the ammeter and voltmeter for R_2?
g) Which resistor dissipates the most power? Guess and calculate.